APPENDIX 4. Case Study: Pennsylvania's Ecology

A4.1 Ecoregions and Geological Provinces. The Commonwealth of Pennsylvania encompasses a whole range of ecological conditions or habitats. As discussed, ecoregions reflect the physical factors that help define the type of habitat present and in turn determines the type of animals and plants that live and survive in that habitat. For example, vegetation is heavily dependent upon the area's elevation, slope, drainage, stability, and nutrient availability, in essence, the geology and soils. Comparing geology and ecoregion maps and noting the similarity of boundaries demonstrates this association. Figure A4-1 illustrates this comparison using the geology province map and an ecoregion map of Pennsylvania. The ecoregion map shows that there are eight ecoregions in Pennsylvania. These ecoregions have been delineated primarily according to vegetation types – each ecoregion contains similar types of vegetation. This is because plants (and animals) have developed and evolved under a certain set of physical conditions characteristic of their ecoregion. The three typical community types or ecosystems within each ecoregion – streams, wetlands, and uplands – are all represented in Pennsylvania.

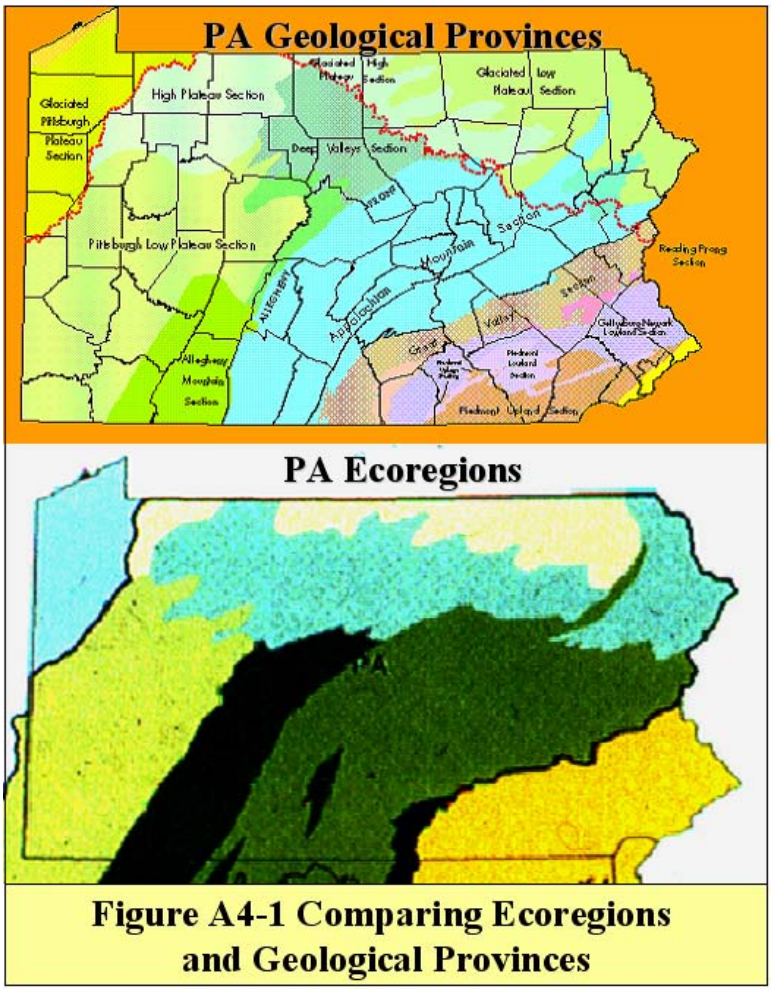


Figure A4-1 Comparing Ecoregions and Geological Provinces

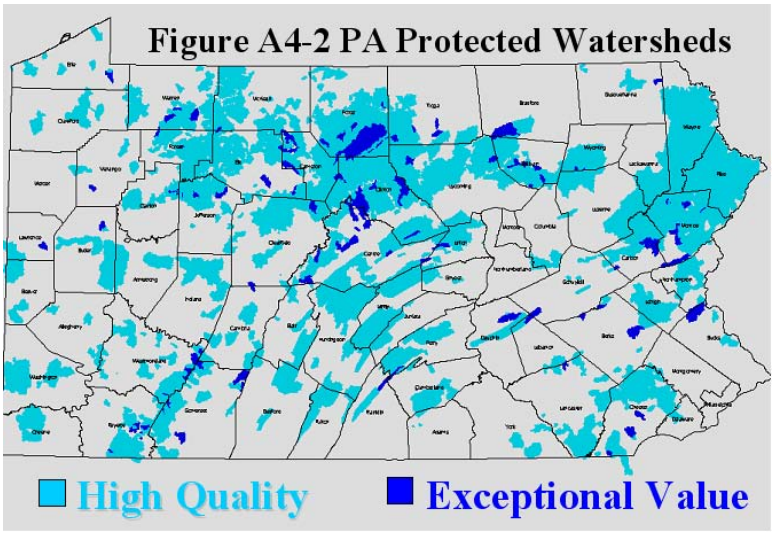
A4.2 Pennsylvania's Stream Ecosystems. The commonwealth has approximately 83,260 miles of streams. Streams systems have played a very large role in shaping the landscape of Pennsylvania, primarily through erosion and deposition of sediments. Much of this activity takes place at a rate that spans thousands to hundreds of thousands of years or geologic time as discussed in Chapter 2, and these processes continue today. For example, approximately 290 million years ago, much of western and northern Pennsylvania was relatively flat and covered with lake-bottom sediments, which later hardened into sedimentary rock. Since that time, erosion has carved numerous stream valleys through these former lake-bottom sediments that are sometimes more than

1000 feet below the level of the surrounding terrain. The process of landscape modification continues today as sediments eroded from a watershed are transported until the water velocities slow and sedimentation occurs as bars in the middle and along the edges of the streams. Sediments are also deposited when floodwaters transport particles outside of the stream channel, depositing them on the floodplain, where they replenish soils along the stream margins.

Pennsylvania derives a number of significant recreation and economic benefits associated with its stream systems. Streams and rivers provide places and opportunities for numerous recreation activities such as fishing, tubing, canoeing, whitewater rafting, bird watching, hunting, and outdoor education. In turn, people who participate in these activities must spend money for gas, lodging, food, sporting equipment, licenses, guides, and many other associated costs. This demand helps provide jobs for local residents. Since many participants live outside the community where the activities take place, there is a significant influx of outside money to the local economies. However, there are costs associated with this tourism, especially their impact on a local government's road system. The timing of tourist activities may be unfortunate – muddy dirt and gravel roads during hunting season can cause tremendous maintenance challenges. The number of tourists viewing the autumn colors may also overwhelm the capacity of less traveled roads. Thus, the condition of a local governments' transportation system can be a great influence – advantage or disadvantage – to the economic growth of the area.

Streams are viewed as a public natural resource in the commonwealth, and, as such, are protected under Pennsylvania's Constitution. To this end, one of the primary goals of managing and protecting streams in Pennsylvania is to maintain a healthy and naturally reproducing fish community. As we have learned, natural reproduction of fish is an important goal because fish are dependent upon a clean, healthy stream environment in which to live. The lack of a naturally reproducing fish community is often an indication that conditions within the stream are degrading.

Pennsylvania has targeted two types of water bodies and their watersheds for "special protection" in order to maintain their existing quality. These two watershed types are described as "Exceptional Value" and "High Quality." They are delineated on a PA map in Figure A4-2. An Exceptional Value (EV) water body is considered to have outstanding water quality, and no degradation of the water is permitted. This is the most stringent protection within the



commonwealth. High Quality (HQ) water bodies are considered to be relatively unaffected by humans. No degradation of the water is allowed unless the PA Department of Environmental Protection (PA DEP) agrees that the project's social and economic benefits justify lowering the quality of the water. HQ protection is slightly less stringent then the EV protection status.

Streams designated as EV or HQ are primarily located in the headwater portions of many Pennsylvania streams. Natural reproduction within these streams is a vital function in order to maintain fish populations and trout is the especially good indicator species. As discussed back in Chapter 1 as a historical perspective, many of the state's roads were laid down next to streams in order to take advantage of the gentle gradient and existing routes of travel. The location of these roads often results in erosion and sediment impacts to the adjacent streams, and resulted in the development and implementation Pennsylvania's Dirt and Gravel Road Program.

Pennsylvania's streams are evaluated by the PA DEP's Bureau of Watershed Conservation, whose focus is maintaining water quality and overall health, and the PA Fish and Boat Commission, who manage the state's recreational fishery. These agencies conduct biological and chemical surveys in their evaluation of the streams and rivers. Data collected from these surveys are then analyzed and used to make management decisions.

A4.3 Pennsylvania's Wetland Ecosystems. The wetland community is an important component of Pennsylvania's ecoregions, with wetlands currently covering approximately ½ million acres, or two percent of the commonwealth. These wetlands provide many valuable services and functions that are beneficial to humans and wildlife, as described in Section 4-4 above.

At the time of European settlement in the late 1700's, there were an estimated 1.127 million acres of wetlands within Pennsylvania, or 4.5% of the state. Back then, as mentioned under Section 4.4, these wetlands were looked upon as wasteland and unproductive land. A great deal of wetlands has been lost in Pennsylvania, with conversion of approximately 56% of the pre-settlement wetlands to human land uses. Typically, wetlands have been converted through dredging, draining, and filling, for a number of different human uses. The conversion of wetlands for agricultural purposes has probably resulted in the

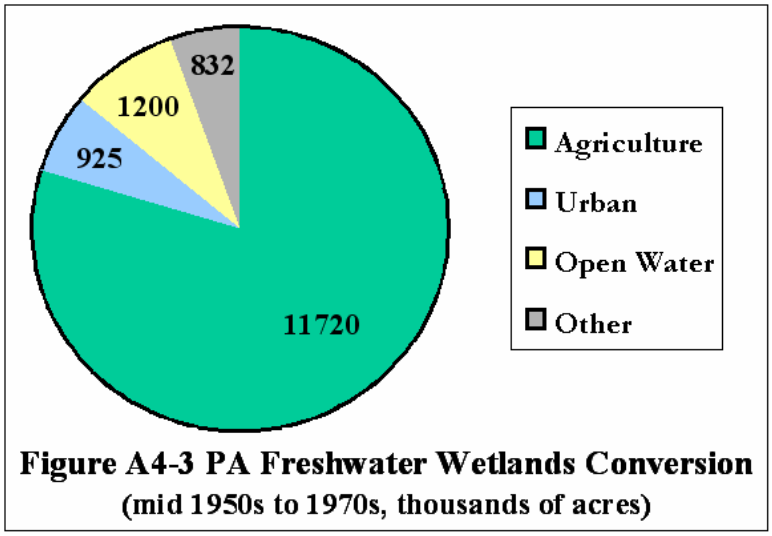


Figure A4-3 PA Freshwater Wetlands Conversion
(mid 1950s to 1970s, thousands of acres)

largest loss. Figure A4-3 shows that wetlands in Pennsylvania have also been converted for urban development, creation of ponds, reservoirs, and lakes, and other forms of development. The loss of wetlands has resulted in a loss of all of the various benefits that they provide.

These valuable natural resources are not evenly distributed across Pennsylvania. The northeastern and northwestern corners contain almost half of the state's wetlands. These relatively small portions of the state contain a large concentration of wetlands primarily because of the impact of glaciers on the underlying geology, topography, and soils. Floodplain wetlands, as previously described, are found along the fringes of lakes, rivers, and streams. This is the most common wetland type in Pennsylvania.

Along with the federal agencies, Pennsylvania has a number of state and local agencies that work to protect the wetland resources, including the PA Department of Environmental Protection, the PA Department of Conservation and Natural Resources, the PA Fish and Boat Commission, and the PA County Conservation Districts.

A4.4 Pennsylvania's Upland Ecosystems. The vast majority of Pennsylvania is uplands. As discussed throughout Chapter 4, plants have physical resource requirements needed to grow and survive. Each species has its own climate, light, moisture, and soil needs. As these conditions vary across the state, plant species are not uniformly distributed. Forest types are commonly named for the species predominant within them. Figure A4-4 shows the forest types of Pennsylvania. Notice the similarity to the previous maps in figure A4-1 showing the geological provinces and ecoregions. Trees are the rule, rather than the exception, along the dirt and gravel roads in Pennsylvania. Management of the forest systems becomes a predominant factor in dirt and gravel road maintenance for Pennsylvania's road managers. Selective tree trimming and limiting shading as described in Chapter 6 are a major component of environmentally sensitive maintenance practices taught through the Pennsylvania Dirt and Gravel Road Program.